NORTHERN LIGHTS

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The sun and earth create lights in the North

Norway's first Sami author, Matti Aikio (1872-1929), grew up under the Northern Lights in Finnmark in the far north of Norway. He writes:
"On an occasional evening, the Northern Lights can be seen to cascade down in incredible abundance – airy, immensely high and colourful waterfalls of fire way up there under all the stars of heaven – and, reflected, sweep over the winter landscape down here – no, there is no sight between heaven and earth that is greater or more overwhelmingly beautiful than the Northern Lights during their great displays up here."

Myths and mysticism are spun around the undulating lights. It was a phenomenon that fuelled the imagination, and gave life to strange stories. The joy created by nature's lavish gala performance was probably overshadowed by fear of the dangerous forces unleashed across the northern skies.

Today, we know more about the nature of the Northern Lights. Through layers of millennium-old beliefs and superstitions, science has gradually uncovered most of the secrets of the Northern Lights, but there is still room for intensified research on as yet unanswered questions.

Only at the very end of the 1800's and into the next century did the theory gain general acceptance that it is the sun and earth, rather than airy spirits, that create the lights in the north. The scientific reality that physicists would eventually be able to present far exceeds the most fanciful myths of the past.

THE INCREDIBLE REALITY

Ten billion years ago, an enormous cloud of gas and dust accumulated far out in space. Gravitational forces caused the cloud to contract into an increasingly compact and energy-filled celestial body. The temperature at the core became increasingly higher, finally triggering a nuclear process. Enormous amounts of energy were forced out to the surface, which began to shine. A new star was born.

As a by-product, planets formed around the new star – among these our own earth, around 150 million km from the sun. Our solar system took shape at the outer edge of the Milky Way, a collection of stars, or galaxy, consisting of between 200 and 400 billion stars.

The birth of a new star was an insignificant event in the vastness of space, where stars are continuously born, and die. Our sun is no giant among the stars, but is situated in the upper stratum, with enough room for 1.3 million planet earths in its interior.

Beyond our galaxy are billions of other galaxies. The farthest that can be seen is 12 million light years away. Most galaxies are from several thousand to several hundred thousand light years in diameter, and are usually separated by a distance of millions of light years. Each individual galaxy is composed of anything from 10 million to 1 trillion stars. A trillion is equal to a thousand billion, or a million million.

Throughout 4.6 billion years, the sun has dominated the sky as a gigantic nuclear reactor, where the core has a temperature of 14-15 million degrees. Every second, 700 million tonnes of hydrogen atoms are transformed into 695 million tonnes of helium. Five million tonnes are released as energy, which throughout millions of years finds its way from the centre of the sun to its glowing surface. Most of the energy is released into space in the form of light and heat, but huge quantities of gas are also thrown out from the sun and converted into electrically charged atoms – ions.

Strong solar winds blow these particles out into space. Some of the particles are blown towards the earth. A magnetic field around the earth receives the dangerous rays and pulls them towards the polar regions, where the the magnetic field forms an oval, centred around the magnetic North and South Poles.

Within these ovals are molecules and atoms, gas particles of mainly hydrogen and nitrogen, which rise up from the earth. The ionised particles from the sun collide with the particles from the earth at a speed of over 1 million km per hour. The gas ignites, and millions of flashes of light in varying colours, depending on the type of gas, move along the undulating magnetic lines 90 to 150 km above the ground.

A LUMINOUS BELT AROUND THE EARTH

In the year 37 AD, an intense red light blazed across the skies above Ostia, Rome's seaport at the mouth of the Tiber. In Rome, the people feared that Ostia was on fire, and Emperor Tiberius sent out an army to extinguish the flames. However, it was not a fire – it was simply the Northern Lights.

Today, the Northern Lights can only be seen from the Mediterranean countries once or twice in the course of a century. In northern Germany, the lights can be seen perhaps once a year, and in the south of Norway perhaps a couple of times a month throughout winter. In Northern Norway, it is theoretically possible to see the Northern Lights on any clear night throughout autumn and winter thanks to the auroral oval, the belt in which the Northern Lights occur. The oval asymmetrically encircles the magnetic North Pole, which is found in the far north of Canada and slightly south-west of the geographical North Pole.

The auroral oval has a fixed position in space relative to the sun from the magnetic north pole, while the earth rotates under the oval with the geographical North Pole as its axis.

While the earth rotates around its own axis once a day, the auroral oval wanders between Svalbard during the day and northern Scandinavia in the evening and night. The Northern Lights stretch across Siberia, Alaska and northern Canada, and over southern Greenland and Iceland.

Most of the energy from the Northern Lights is played out over inhospitable regions with low temperatures. Northern Norway is an exception, with inhabited areas and a milder climate. In the afternoons, the coastal areas in northern Nordland, Troms and Finnmark move under the auroral oval, and therefore have the strongest and most active Northern Lights, which appear in the midnight sector of the oval.

Most of the amazing play of colours is not usually visible to the human eye. We need a dark sky against which to view them. When the August darkness settles over the northernmost areas of Norway, the Northern Lights reveal themselves once again. The Northern Lights are clearly visible until the middle of April, but statistically, October, February and March have the most Northern Lights. The chance of seeing the Northern Lights is greatest a couple of hours before midnight and in the early hours of the new day.

The strongest Northern Lights generally occur about 27 days apart, in connection with the sun's rotation period. In addition, the activity of the Northern Lights varies with sunspot periods, which culminate every 11 years. The dark spots on the sun indicate an intense magnetic activity with huge eruptions, with visible manifestation in the form of intense Northern Lights.

Myriad mystical myths

After the ice receded, nomadic peoples began to wander further north. Ten thousand years ago, humans might have stood on the frozen land with a multi-coloured night sky above them, and wondered what this could be. The incomprehensible gave free rein to the imagination, and in the absence of science, they established faith.

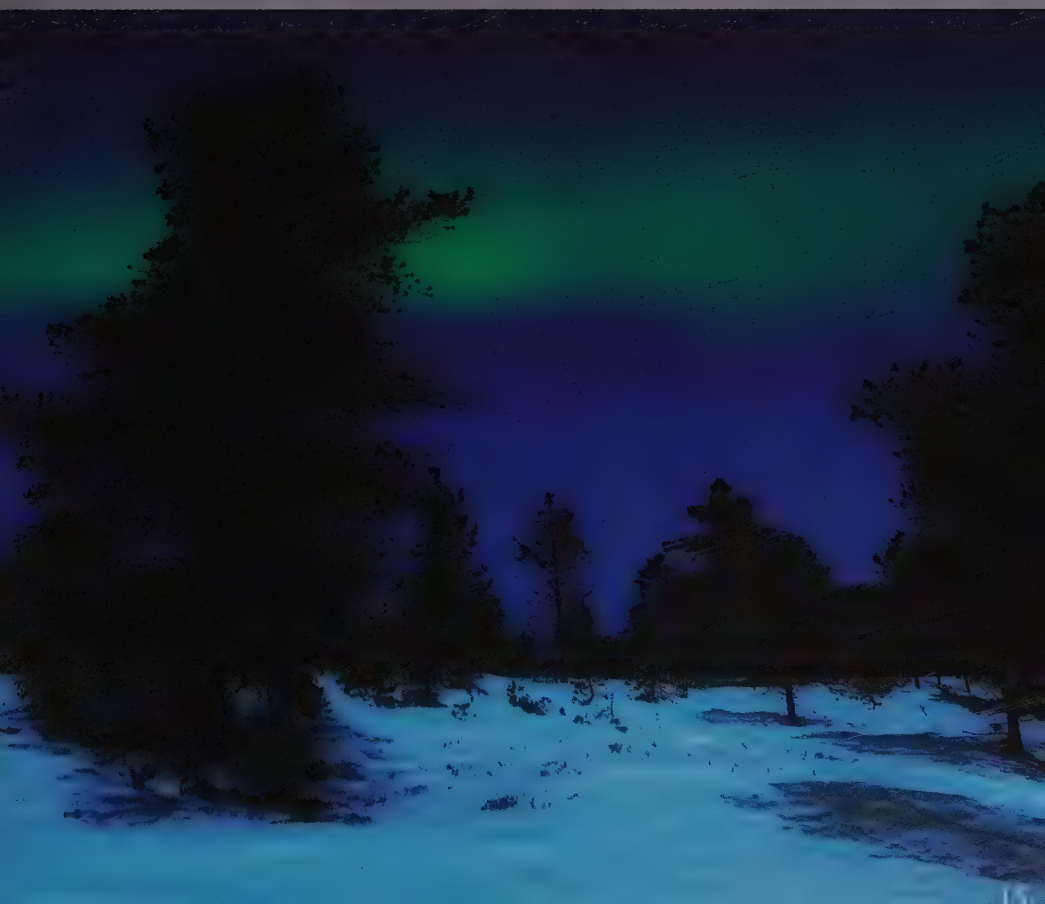
Thus, mystical stories were created around the Northern Lights. They provided contact with an imaginary spirit world, where positive forces could be found, but also dangerous, destructive forces.

Everywhere under the auroral oval, the Northern Lights have been connected to dead souls. Those who had experienced an abrupt or violent death could live on in the Northern Lights. The Northern Lights could be the souls of stillborn or murdered babies. Young girls who died could gain a place in the Northern Lights, as well as older, unmarried women. Contact could be established with

the dead by waving to the Northern Lights, but this was not without risk. The Northern Lights might perceive waving and whistling as inappropriate teasing or ridicule, and come down to exact a terrible revenge. But to this day, children under the Northern Lights have waved at the evening sky and probably felt a mixture of terror and excitement at the thought that the Northern Lights might come down and get them.

Appealing shapes and playful movements have created widespread associations with virgins, dance and death.

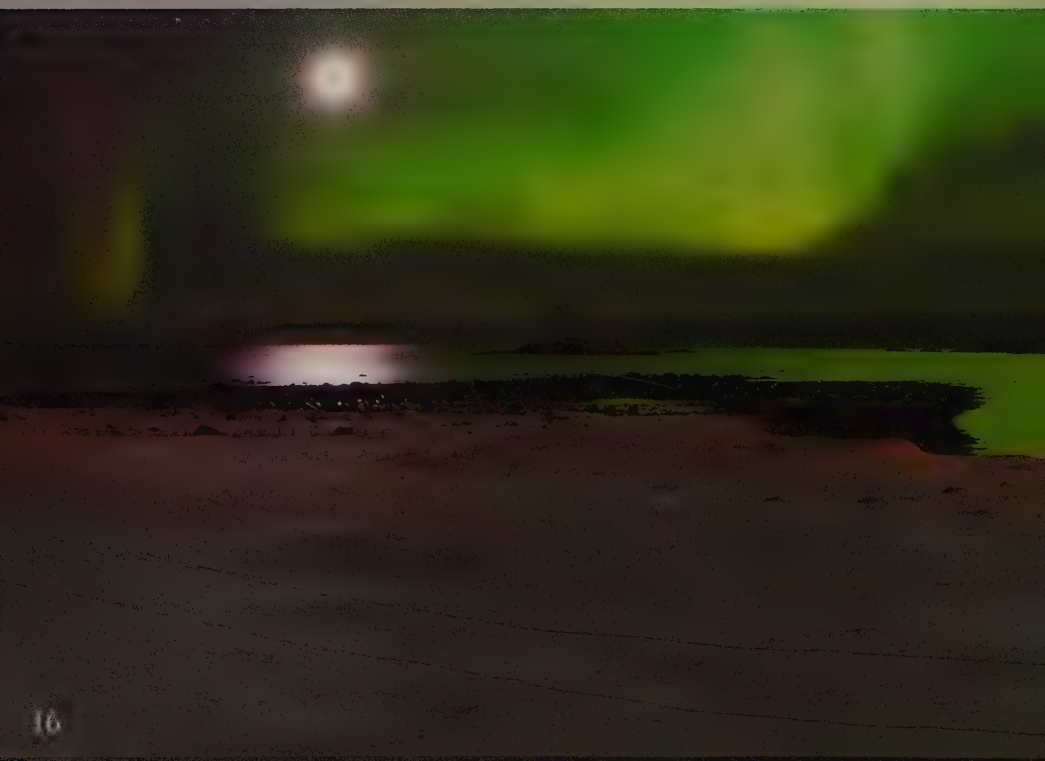
The Native Americans interpreted the Northern Lights as the dance of the gods or spirits, while the Inuits saw spirits dressed in a mystical light, which provided some merriment while the sun was gone. The rapid movements of the Northern Lights were called "the dance of the dead" by the Inuits.



Among the Sami people, the Northern Lights were one of the important signs of the "runebomma", the Sami shaman's magic drum. Through "joik", traditional Sami chanting, friendly spirits from the other side could be invoked, and disputes could be settled under the Northern Lights. In Sweden, people believed that the lights were caused by Sami people who were out with torches, looking for reindeer.

In Norway, it was believed that the Northern Lights were a reflection of large shoals of herring or other fish in the sea, and in coastal areas were referred to as the "herring lights". In Finland, people believed that the lights might be reflections of the waves created by whales playing in the sea. They also kept a close eye on large forests, where there was a special kind of fox that triggered the Northern Lights when its tail slapped against tree trunks or straw. In Sweden and Denmark, it was believed that swans, frozen in the ice fields of the north, created the Northern Lights by beating their wings.

In Iceland, expectant mothers were warned not to look at the Northern Lights, because this might result in a cross-eyed child. The Chuvas Indian tribe had a Northern Lights god, who foretold whether an expectant mother would be so fortunate as to give birth to a son. The god also assisted during the birth. In China, the Northern Lights bore a message that mothers might be expecting children. Japanese couples often travel to Northern Norway on their honeymoon. The Northern Lights can ensure a long and happy marriage – and it is also lucky to conceive a child under the play of colours in the sky.



Alarming signs in the sky

One day in March in the year 44 BC, the Northern Lights surged across the skies above Rome. In the Northern Lights, both cavalry and infantry could be seen, but it was not until after the assassination of Julius Caesar on 15th March that people truly understood what signs of foreboding were present in the heavens.

It is said that the Northern Lights hovered above Jerusalem when Titus, the future emperor, destroyed the town and its temple in the year 70 AD. This marked the beginning of 2,000 years of life in exile for the Jewish people.

In the year 451 AD, Attila the Hun's powerful army was stopped by the Romans and Visigoths in an historically decisive battle on the Catalaunian Plains in Gallia. The Northern Lights could be observed across the sky throughout the battle. The blood of martyrs often made its way up to the heavens and appeared in the Northern Lights. This also happened in the year 1170, after Henry II of England's men assassinated Thomas Becket in Canterbury Cathedral.

On 20th March 1345, the planets Saturn, Jupiter and Mars were in a triple alliance in the 40th degree of Aquarius. This unleashed a bubonic plague, which ravaged Europe from 1347 until 1351. This plague, which resulted in a terrible, painful death for an estimated 50 million of Europe's 80 million inhabitants, became known as the Black Death.

We know the reason for the plague's occurrence because it was explained in a highly-respected study written by doctors from the medical faculty of the University of Paris in 1348, at the request of the French king, Philip IV. The report from Paris bears witness to the prominent role various celestial phenomena played in the lives of humans. That which one saw, or believed one saw, was interpreted as a divine warning. The Northern Lights were central to these beliefs. The further south one travelled, the more rare the Northern Lights were, and usually of a more reddish hue. In addition to being regarded as a messenger of times of war, strife, plague and poverty, the Northern Lights were also seen as a biblical reminder that both heaven and earth were doomed to perish in fire.

Neither secular nor spiritual rulers passed up this opportunity to point out that the strange lights in the sky were a clear warning against disobedience to the authorities, and a call to pay increased taxes and tithes with gladness.

From popular beliefs to scientific truths

A miraculous sight was seen over large areas of Central Europe on 12th January 1570. For four hours, the sky was filled with strong lights and blazing fire, and ran red with blood. Never in human memory had such a terrible sight been seen or heard of. Guards proceeded to sound the alarm bells, and an account from Bohemia states: "Therefore, dear Christians, take this gruesome sign to heart, and pray to God that he shall lessen our punishment."

It was the intense Northern Lights that had terrified the people, at a time when auroral activity was generally non-existent. From the 1300s and until the middle of the 1800s, there was great climatic instability throughout the world, but Northern Europe was hit the hardest. There were great variations in temperature, and the lowest temperatures were reached in the 1700s. This period is known as the Little Ice Age, and was characterised by crop failure, famine, illness and death. This triggered off the French Revolution.

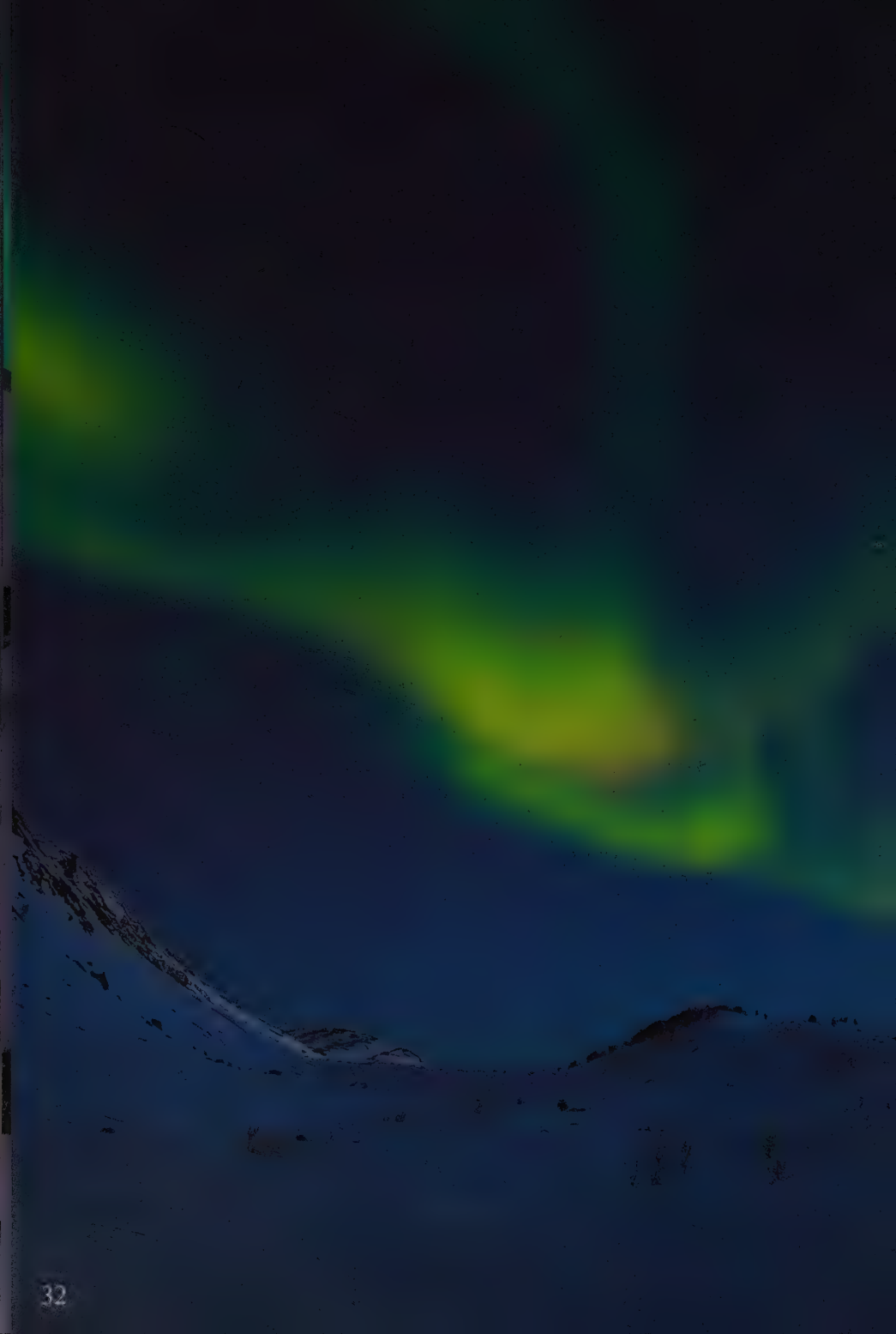
Those looking for the reasons behind the Little Ice Age point to natural variations in the sun's radiation, combined with airborne particles from an unusually large number of volcanic eruptions and changes in oceanic currents.

The Northern Lights were generally unfamiliar phenomenon from the 1400s to

the middle of the 1800s, but on rare occasions an enormous eruption would occur on the surface of the sun. These eruptions, which we call solar flares, influence only a small proportion of the Northern Lights in the north, but create most of the intense Northern Lights that can be seen in southernmost Europe.

Such an eruption was probably the cause of the miraculous event that shook Central Europe in 1570. The Northern Lights then went into hibernation for a period of one hundred years, and memories of their existence faded. So when intense Northern Lights once again blazed over Central Europe in March 1716, many thought that this was a completely new phenomenon.

From this point onwards, scientists threw themselves into studying the Northern Lights with great enthusiasm. In 1741, Swedish physicist and chemist Anders Celsius abandoned the belief that the Northern Lights were created by fire-breathing mountains below the North Pole. He saw the connection between magnetic storms and the Northern Lights, without linking this with the sun. The research brought forth an ever-increasing number of new discoveries, but popular beliefs have endured alongside these in all their colour and richness, right up until the present day.



Norwegian physicists found the answer

By the end of the 1700's, enlightened circles were also done with mystical and metaphysical theories about the Northern Lights. In the 1800s, scholars focused on finding natural explanations for a natural phenomenon. More or less probable theories were introduced, tested, and discarded while fumbling towards a result.

Scientists touched upon conditions in the sun's atmosphere and electrical discharges along the auroral arcs. Great attention was paid to the earth's magnetism, and the search for geomagnetic poles began. The magnetic north pole was proved to exist in 1831. The connection between sunspots and Northern Lights activity was also examined, and theories about the polar ovals were put forth. The first organised international research was started towards the end of the century. Leading Norwegian researchers asserted themselves, and one of them was able to provide a definitive answer as to how the Northern Lights occur.

His name was Kristian Birkeland – the man who in 1896 presented his ground-breaking theory about how particles from enormous eruptions on the sun, in ionised form, are carried towards the upper layer of the earth's atmosphere by the solar winds, where they collide with particles from the earth in the ovals above the magnetic poles. Upon impact, the gases are ignited and produce different colours, depending on what kind of gas the particles from the earth contain. Billions of such momentary blazes cause the polar lights to undulate within the ovals around the magnetic poles in the north and south.

Several other Norwegian Northern Lights researchers were also undertaking ground-breaking projects at the same time as Birkeland. From the end of the 1800s and until today, Norway has held a leading position within international Northern Lights research, both through the country's geographical placement and through the results Norwegian researchers have been able to deliver, whether individually or as part of an international team on Norwegian soil with their gaze directed towards the Northern Lights – which still present many unsolved mysteries.

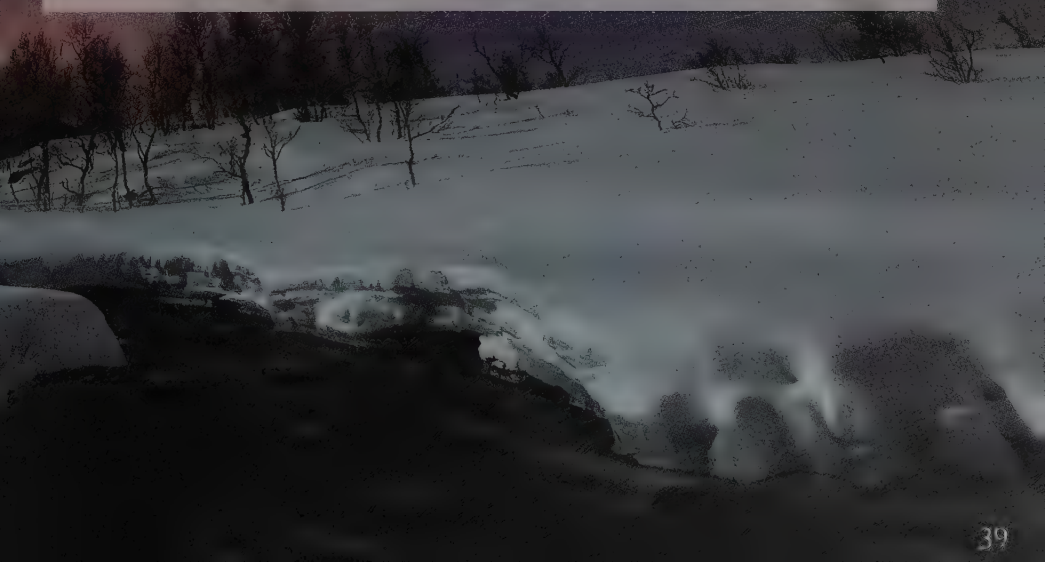
Observing the Northern Lights

In 1838, with King Louis-Philippe as an active supporter, the French research vessel "Recherche" set out towards the north to carry out scientific surveys on Spitsbergen and in Finnmark. Five of the participants established a research station in Bossekop in Alta in order to study the earth's magnetism and the altitude of the Northern Lights. Thus started a sequence of events which led to Alta, Finnmark's largest town, being known as "the town of the Northern Lights".

The observations were continued until 1849 by the Videnskabsselskab (scientific company) in Kaafjord, which comprised engineers at the copper works in operation in Alta at that time. As the first international year of polar research was coming to an end in 1882-83, the Norwegian main research station was established at Bossekop. The world's first preserved photographic image of the Northern Lights was taken here on 5 January 1892 during a German Northern Lights expedition.

The Danish-Norwegian meteorologist Sophus Tromholt was among those to make his mark in auroral research. He calculated the mean altitude of the Northern Lights to be 113 km, and published a book about them in the 1880s.

The altitude above the ground of the Northern Lights was a hot topic in research circles throughout the 1700s and 1800s. Estimates ranged from ground level to over 1,000 km. People reported that they had to bow their heads under the Northern Lights, and in Alta a story circulated of a rowing boat with a trustworthy crew, who in 1881 were caught and enveloped within amazing Northern Lights that swept across the fjord.



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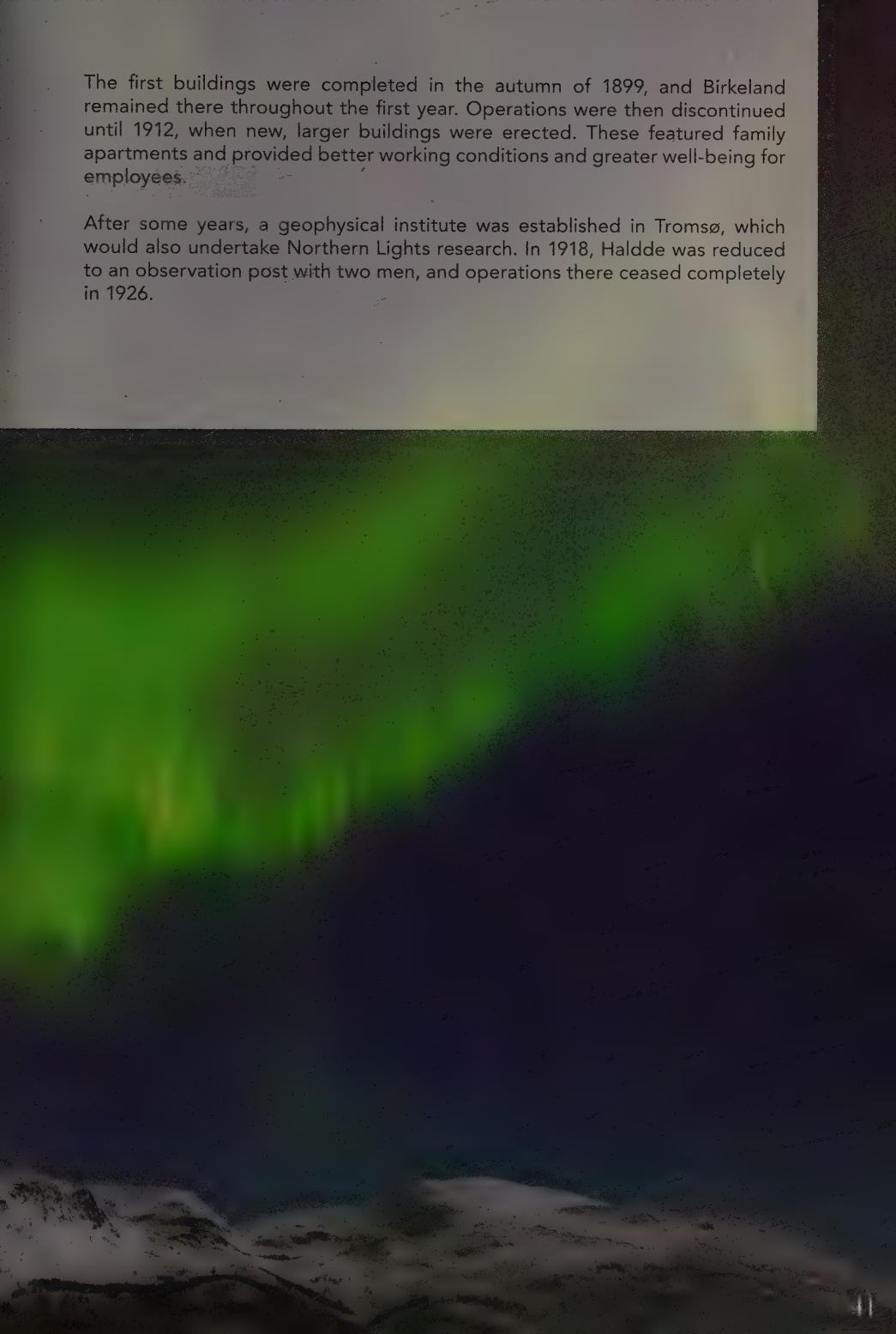
Norwegian Northern Lights' researcher Carl Størmer took thousands of photographs of the Northern Lights in Alta from 1910 and onwards. He could prove that the mean height for the Northern Lights is 110 km. Most Northern Lights occur at between 90 and 150 km above the ground, never below 70 km, rarely below 85 km, rarely above 200 km, but can occur all the way up to 1,000 km. This is still recognised as the correct altitude.

But before researchers came this far, the great Kristian Birkeland also listened with interest to stories that the Northern Lights had been seen both on mountaintops and in treetops. Birkeland's reputation as a researcher convinced the Norwegian Parliament to grant funding for the world's first Northern Lights observatory. Birkeland travelled to the Alta area to find a suitable mountain, and was about to perish in the wind and cold when he decided on Halddetoppen in Kåfjord.

The first buildings were completed in the autumn of 1899, and Birkeland remained there throughout the first year. Operations were then discontinued until 1912, when new, larger buildings were erected. These featured family apartments and provided better working conditions and greater well-being for employees.

After some years, a geophysical institute was established in Tromsø, which would also undertake Northern Lights research. In 1918, Haldde was reduced to an observation post with two men, and operations there ceased completely in 1926.



The colours of the Northern Lights

Lars Vegard is one of the great Norwegian Northern Lights' researchers from the pioneering age of the first half of the 1900s. He published as many as 180 scientific works before his death in 1963. His ground-breaking work was to map the colours in the Northern Lights, and explain how each occurred, depending on the kinds of gas ignited in the collision of particles from the sun and earth, the temperature of the gas, and at what altitude this happens.

Oxygen and nitrogen are the most important gasses from the earth. The yellow-green colours from oxygen dominate at lower altitudes, while oxygen can also give red Northern Lights at higher altitudes. A blood red colour can occur during particularly large outbursts of the Northern Lights as a result of high solar activity.

Nitrogen gives blue-violet colours, as well as red, depending upon the altitude. Otherwise, it is the seamless blending of different colours that characterises the magnificent Northern Lights experience – the shifting shapes, the rapid scene changes. The Northern Lights follow the earth's magnetic field, and can move across a stretch of 100 km in just one second.

In addition to the colours in the visible part of the spectrum, the Northern Lights also contain ultra violet and infra red light, which are not visible to the human eye. Intense Northern Lights can illuminate the night sky to the same extent as a strong full moon.

Crackling light and music of the spheres

Throughout the ages, there has been a widespread belief that the Northern Lights can be heard. The Sami call them "guovssahas", the audible lights. However, no instruments have managed to record any sound, and researchers are perplexed as to why it would be possible to hear the Northern Lights from the ground when they occur at an altitude of 80 to 250 km.

What has been observed is a crackling sound from the electromagnetic waves in the upper atmosphere. The sound is inaudible to the human ear, but can be heard with the help of a radio receiver. Composers have created works based on this sphere's somewhat discordant music.

Open-minded researchers do not exclude the possibility that some auditory nerves may be affected by electrical discharges. The Norwegian physics professor Alv Egeland puts it this way: "It is impossible, from a purely physical point of view. Nevertheless, I believe that there is still a great deal that we have not yet discovered at the frontier of science, but this is primarily due to a lack of observations".

Tromsø becomes a Northern Lights Centre

In 1928, the Northern Lights Observatory in Tromsø was established as a department of the Norwegian Institute for Cosmic Physics. The American Rockefeller Foundation funded the buildings, which Norway was able to staff with the world's most prominent Northern Lights researchers. The Northern Lights Observatory has changed its name to the Tromsø Geophysical Observatory, and is now a part of the Department of Physics and Technology at the University of Tromsø.

The observatory was situated in rural surroundings at the time of establishment, but observations were eventually disrupted by the growth of the city. In the 1970s, Ramfjordmoen just outside Tromsø was established as a new observation post. This has now become one of the world's most important bases for atmospheric research.

Among the advanced instruments at Ramfjordmoen are magnetometers,

which measure the strength and direction of the earth's magnetic field. These instruments, along with others at the university's Northern Lights station on Svalbard, are part of a global network which continually collects data for international archives. An ionospheric heater is also stationed here. With a beam strength of over 1 GW effective radiated power, it can reach the ionosphere for more detailed studies, and can also produce artificial Northern Lights.

Most striking are the two EISCAT radars. The antenna dish of one of the radars measures 30 m in diameter. This radar operates in the UHF range. The other radar operates in the VHF range, with an antenna that is 120 m long and 40 m wide. The signals are also transmitted to receiver stations in Sweden and Finland. EISCAT (European Incoherent Scatter Scientific Association) is a collaborative scientific project between Norway, Sweden, Finland, Great Britain, Germany, Japan and China, for studies of the interaction between the sun and earth and the processes in the ionosphere and magnetosphere.

Svalbard – a window out to space

For 350 years after the discovery of Svalbard, hunting peoples were widespread in the north. A mining community was first established in around 1900 in order to utilise the large coal deposits created by the rich tropical vegetation that covered Svalbard millions of years ago. Mining is now on the wane, while high technology and research have become the new, large growth industry on the group of Norwegian islands approximately 1,200 km from the North Pole.

Svalbard has become the world's most important space observation post and a hub for international satellite communication and the monitoring of satellites, including through Svalbard Satellite Station, SvalRak, and SvalStat, a launch base for research rockets in i Ny-Ålesund, which is owned and operated by Andøya Rocket Range.

Svalbard has achieved a dominant position in Arctic research and climate- and environmental monitoring throughout the world. A number of research institutions have been established, often through collaborative projects between several nations, and researchers from across the world shape this international environment.

The gigantic EISCAT radar in Longyearbyen has two antennae measuring 32 metres and 45 metres respectively in diameter. This and many other installations here and in Ny-Ålesund are at the disposal of researchers. Svalbard also has the world's northernmost ground station for the European Space Agency's global satellite network Galileo, which is intended to provide a secure and effective navigation system and supply the entire world with precise positioning data. The University Centre in Svalbard (UNIS) has students from across the globe, and offers tuition in biology, geology, geophysics and technology in Arctic conditions.

The Northern Lights Observatory in Tromsø started the first systematic observations in Ny-Ålesund in 1966. In 1978, a Northern Lights observatory was opened in Longyearbyen. After many years in cramped conditions, a completely new observatory was finally opened in 2008. This is the world's northernmost and most modern observatory for studies of the Northern Lights and atmospheric physics, all the way up to an altitude of 1,000 km, through the use of ground observations, rockets and satellites.

Launching rockets into the Northern Lights

On 4 October 1957, the Soviet Union made space history by launching the world's first artificial satellite. Sputnik 1 weighed 83.6 kg and circumnavigated the earth in its orbit until it self-destructed during re-entry after three weeks.

These weeks were of historical significance for space research, and Norway became a key player in this extraordinary development, thanks to the country's location and solid research environment. Five years after Sputnik 1, the first rocket was launched from the newly-established base on Andøya. In the space of the next fifty years, until 2012, more than 1,000 launches of scientific rockets have been carried out. A number of research balloons have also been sent up.

Andøya is situated in the far north of Nordland county, at 69 degrees. In the north there is open sea all the way to Svalbard, and in the west all the way to Greenland. Andøya Rocket Range is the northernmost installation of its kind in the world. It is owned by the state administrative body the Norwegian Space Centre, with Kongsberg Defence & Aerospace AS as a 10 % partner.

In addition to three large launch pads on Andøya, there is also one in Ny-Ålesund on Svalbard. Andøya Rocket Range AS is a high-tech company which offers a broad range of services. The organisation is also responsible for the operation of the Norwegian Centre for Space-Related Education. From 2017 and onwards, smaller satellites may also be launched from Andøya.

Most of the rockets are small, and are launched to a height of 90-100 km for meteorological purposes, but generally one or more large rockets are launched to higher altitudes each year. A record of 1,478 km was set in 2008, with a rocket that went from Andøya over Svalbard with a flight time of around 30 minutes.

It is expensive to launch a rocket from Andøya or Ny-Ålesund, costing from less than 10 million Norwegian kroner for a small rocket, to several tens of millions for a large one. A Northern Lights rocket can easily cost 15-20 million Norwegian kroner.

Powerful forces in space

The primitive peoples of the north have probably always navigated according to the Northern Lights, which move approximately from east to west. Today, ships and planes navigate with the help of satellite signals, and cars drive with a GPS unit on the dashboard. Radio waves are disrupted by the Northern Lights in all frequency ranges, and cosmic turbulence in areas above the Northern Lights' altitude can cause problems for satellites. It is important to clarify the physical processes behind this.

Norway has long since claimed a place as an important astronautics nation, and the state administrative body, the Norwegian Space Centre, has declared that Norway has set its aim on being the country that reaps the greatest benefits from space of any country in the world by 2015.

In 1859, the powerful forces out there acted in a way that still gives cause for concern. Unusual activity could be observed on the surface of the sun. Billions of tonnes of burning gas were flung out into space from a large group of sun spots. Just 17 hours later, huge quantities of electrically-charged particles entered the earth's magnetic field at a speed of 8.3 million kilometres per hour.

The collision created the greatest display of Northern Lights ever of our era, not

only over northern regions, but almost as far south as the Equator. The lights were visible in Hawaii. In Cuba, people read the newspaper under the Northern Lights. Gold diggers in the Rocky Mountains got up and made breakfast, thinking it was morning.

We are living in a period with extreme solar activity, and our high-tech society is discussing preventive measures against a new extreme eruption. This applies, not only to vital power supplies on earth, but also to telecommunications and navigation systems linked to satellites and space stations. Future weather reports will continue to predict sun or rain in the local environment, but also provide space reports for particle radiation and electromagnetic fields. Monitoring, data collection and research on Norwegian soil will be of significant importance.

Considerable financial resources are needed to launch a research rocket worth 15-20 million Norwegian kroner or more which will splash down into the sea after just a few minutes' flight through the Northern Lights However, it may be more costly to do nothing, since the Northern Lights are a significant source of information to aid our understanding of the processes in space that affect our planet.

A journey to the Northern Lights

"No, no sight between heaven and earth is greater or more overwhelmingly beautiful than the Northern Lights during their great displays up here. They should be able to attract just as many tourists here in the winter as the Midnight Sun does in the summer." So wrote Norway's first Sami author Matti Aikio about 100 years ago.

Since then, the Nidnight Sun has attracted tourists to Northern Norway in numbers that would have been inconceivable 100 years ago. In recent years, Northern Lights tourism has also exploded.

Nine airports in Northern Norway which have capacity to receive charter flights from abroad are now marketed as Northern Lights Airports. The Hurtigruten Coastal Steamer has had great success with its marketing of Northern Lights experiences along the northern coastline. Cruise ships set out on winter voyages to Northern Norway with the Northern Lights as their main attraction, and Alta, the "town of the Northern Lights", as their final destination. Alta offers overnight stays in a hotel built of ice, and dog sledding trips to experience the Northern Lights out in the wilds, far from civilisation and city lights.

Kirkenes can also offer an ice hotel and Northern Lights trips out into unspoiled natural territory. Northern Lights experiences in Northern Norway are not limited to travel by dog sled, but also include trips by snow scooter, car, bus, reindeer, horse, kick sled, and snow shoeing expeditions. You can choose between a cabin cruiser, catamaran, local boat or fishing boat. Some serve fresh waffles, others freshly cooked fish or hot soup. Out in the open, far from civilisation, you can experience a spa, jacuzzi, sauna, or a hot tub under the open sky – perhaps under the undulating Northern Lights. If you think you have tried everything else, you can also try sleeping in a lavvo (a Sami tent) , far from city-life and comfortable hotel beds.

The Polar Lights Centre in Laukvik in Lofoten offers night walks down to the shore to see the Northern Lights above the open sea. At Tromsø Museum, you can create your own Northern Lights using the model of pioneer Kristian Birkeland's ground-breaking experiment that formed the basis for modern Northern Lights research. In Tromsø, the Northern Norway Science Centre has a planetarium with exhibits of the Northern Lights and the night sky, and the Polaria Experience Centre has been a great success. Here, a film called "Northern Lights in Arctic Norway" will be of particular interest to Northern Lights tourists. The film is followed by an "Arctic walk", which gives visitors close contact not only with the Northern Lights, but also snow storms, polar bears and other aspects of life in the Arctic.

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